

STAT

TEST AND EVALUATION REPORT

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WIDE FILM PROCESSOR

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TEST AND EVALUATION REPORT



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WIDE FILM

PROCESSOR

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FOREWORD

STAT The purpose of this test and evaluation was to establish the parameters for acceptance of the [] Processor by the using agency and evaluate the design and operation of the liquid and air bearings. The liquid and air bearing, although not new in concept or use, is utilized in the machine in a different configuration than previously attempted in a processor of this size. In the machine the liquid "bearing" is also the applicator for chemistry, and the air "knife" serves both as a support and a means for limiting carryover between solution compartments.

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SECTION I

ENGINEERING EVALUATION

A. GENERAL

Evaluation and subsequent testing were accomplished as outlined in the attached program. This phase is objective insofar as design, workmanship, materials utilized in the fabrication of the machine and in general, good engineering principles and practice.

B. TEST PROCEDURES AND RESULTS

1. Test procedures are as outlined in Appendix I, and results are as follows:

a. An examination of the processor after uncrating, as well as during and after installation, revealed no damage to the machine. One pump was loose on its base but was easily secured. All support equipment was found to be in good condition. The exhaust blower motor was changed from 110 Vac to 220 Vac for more efficient operation after approval was received from [] Project Engineer []

[]
All connections (plumbing, electrical, air and vacuum) were checked and found to adhere to specifications.

b. All stainless steel and PVC work was excellent. Installation of the processor was accomplished without problems, due to minimal plumbing and wiring requirements.

c. All systems were checked in sequence as outlined in the manual. Results were good in all aspects, with the exception of temperature and its control.

d. Air and vacuum units checked and accepted.

e. Air squeegees, air bearings and vacuum roller accepted and considered well designed.

f. Film transport of a total of 2,000 ft. each of 70 mm and 9.5-inch thin and heavy base (including 500 ft. of heavy film leader) film was excellent. All tanks during

this phase were water filled, and machine was in full operational configuration for dry-to-dry evaluation. No abrasions or edge distortions were noted.

Temperature control was tested during all runs and temperature variations from liquid bearing impingement area to control indicator varied three to seven degrees. This phase was rechecked during the first sensitometric run and the differences ranged from two to three degrees.

g. Electrical components all acceptable and meet specifications.

h. Mechanical components were accepted with the following deficiencies noted.

(1). The film magazine, due to modification, will not accept the Air Force 1,000 foot spool and the light trap remains open when attached to the machine. Use of an Air Force standard magazine, that adapts to the machine, and with a full 1,000 feet of film causes base abrasions in passing through the entry slit to splicer section. Unless modified, the light trap on the Air Force magazine will remain in the "open" position. Opening of the splice area could fog loaded film.

(2). Front take-up roller "drawer" requires excessive force to remove and when in "operating" position, the air blast noise increases in intensity to an objectionable degree and causes continuous flutter of the film, which in turn causes lateral abrasions of the film.

(3). Speed control knob increments are too small for accuracy and require a tachometer to establish a true film trend speed. The use of the conversion chart to convert the arbitrary numbering system is of little value. As an example, the [] STAT [] Engineering Manual recommends a speed of 4.75 ft/min. for drying [] STAT film, but the increments on the conversion chart do not include this figure. A direct reading speed selector, calibrated in ft/min., is required.

(4). Temperature control units, unless started with cool chemistry, are difficult to adjust. Calibrated controls on each unit would be of considerable value. Lack of a cooling system makes the required temperature adjustments a time consuming and tedious task, particularly in respect to the allowable tolerances involved in $\pm 0.25^\circ \text{F}$ control.

NOTE

In tests these tolerances were not held at the film impingement plane.

(5). The drain pan should be extended to include the wash tank section and the drainage outlet should be made larger.

(6). Full opening and draining of all tanks at one time is not possible due to limited pan capacity and small drainage opening.

(7). Noise level extremely high. The exhaust blower should be mounted away from work area and redesign of the dryer assembly is recommended in order to lower the noise level and also reduce film flutter (Ref. B-1-h-(2) above).

(8). Leakage or spillage drains onto electrical motors and pumps.

(9). 1,000 foot roll pull through causes wrinkling at the 90 degree turn-around, take up idler roller.

NOTE

Due to the power requirements and physical characteristics of the processor, it is estimated that a minimum of eight to ten tons of air conditioning will be required to maintain equilibrium for the specified $70^{\circ}\text{F} \pm 5^{\circ}$ and $50\% \pm 5\%\text{RH}$.

i. Dryer is inadequate and it is apparent that processing speeds, types and temperatures of chemistry are all dependent on the drying capability.

This phase of the test, although involving chemistry, will not be included in Section II, but will be mentioned at this point. Deficiencies noted, based on high temperature processing, are as follows:

(1). The ratio of metal to hydroquinone is high.

(2). Sodium sulphite concentration is not high enough.

(3). It is our opinion that borax should be added to the hydroxide alkali buffer system.

(4). Sulphate should be added to prevent the excessive swelling which is one of the primary reasons for the film drying problem.

NOTE

Chemistry tests will be continued in Section II

C. CONCLUSIONS

STAT The [] Processor, as a prototype, is good in concept with exceptions noted in paragraph B-1-H. The air knife and liquid bearing-applicator principles have been well adapted to the photographic process, and they do establish that it is possible to transport film with little or no abrasions, scratches or other defects that have been one of the major problems in film processing machines. The dryer section is poor in design. The loading design and drying section negated the possibility of transporting film dry-to-dry with no abrasions in the processors present configuration.

D. RECOMMENDATIONS

From an engineering standpoint, the machine, as a prototype, is acceptable if the deficiencies noted are corrected. This recommendation does not include or pertain to the acceptability of the processor as a sensitometric, chemical, or controlled process machine. These questions will be discussed in Section II.

SECTION II

SENSITOMETRIC EVALUATION

A. GENERAL

Evaluation and subsequent testing were accomplished as outlined in Appendix I, but due to the deficiencies noted in Section I Engineering Evaluation, the complete series of sensitometric tests was not considered feasible at this time. The purpose of this testing was to establish a basis for the acceptance of the processor by the using agency. Specifications, as set forth by the using agency, were not available, but an objective approach to the evaluation was followed and limited to the quality of the product and sensitometric stability.

1. Test Procedures

Test procedures that were used deviated from the original program and will be presented within the confines of the actual tests accomplished.

a. Chemistry - Sensitometric curves representative of processing runs indicate that high temperature and high agitation turbulence (potential oxidation of developing agent(s) upset the formula balance, creating instability in the sensitometric control. The replenishment is based on a "demand" principle and varies from 1 to 3 quarts of developer during the processing of 500 feet of film, (70 mm and 9.5-inch wide). Replenishment of other solutions vary according to capacity of their respective tanks. A foam buildup was apparent in the wash section. Although not excessive, it caused a slight overflow around the edge of the cover. Reference Testing for Correlated Deficiencies.

b. Sensitometric - Limited sensitometric testing was done with []
[] film. Dryer problems encountered in testing [] prevented a thorough
evaluation of this film.

NOTE

Discussion with the using agency resulted in limiting the testing to the two duplicating and one acquisition film; therefore, only the NRD-29 developer was used in accordance with the [] Manual.

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STAT Testing of the [] fine grain duplicating film and [] acquisition film showed good drying of these materials is possible, although the temperature control of the infrared heater unit was somewhat critical. High velocity air turbulence in the dryer section caused lateral abrasions on both film types. STAT

Lateral density plots showed variations on [] film up to .04 density. Density variations on [] film were as high as .06 at a nominal density of 1.5. STAT

STAT B. CONCLUSIONS

STAT The [] wide film processor prototype, from the standpoint of precision, high quality controlled processing, is not acceptable. As stated in Section I, although good in the concept of the [] principle (air knife and liquid "bearings"), the processor is lacking in good engineering practice in respect to satisfactory loading-splicing design. Also the volume of drying air has not been controlled, or baffled, thereby creating excessive film flutter which is the major cause of the film abrasions that are apparent on test films processed (which include thick and thin bases.) Sensitometric control is not possible and can be attributed to the Replenishment System which is a "demand" type system. On a processor of this design, it is not controllable. For precision processing it was noted that the developer replenishment bottle, due to back pressure in the circulation system, received "back up" of oxidized developer. The unpredictable flow of chemicals and the lack of sufficient fresh chemistry in the system not only changed the chemical balance, but a definite increase in KB_T was noted. High temperature processing required by the short developer time in the processor will require chemistry other than recommended in the [] Manual. STAT

In the dryer section, the infrared, in conjunction with warm air impingement, requires critical and balanced control and could be considered extremely difficult with the existing configuration and control system. The distance between the wet section air knife, and the infrared area, then into the film guide air cluster, is too short. At this critical point drying is minimum upon entry into the cluster causing the flutter abrasions to be unacceptable by normal standards.

STAT The [] Processor is not acceptable in its present design as a controlled process unit.

APPENDIX I

TEST PROCEDURE OUTLINE
FOR THE [] PROCESSOR

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1. Purpose

The purpose of the test program is to determine if the [] processor meets the specifications as outlined in this test plan. The processor must perform within the outlined standards to be considered acceptable.

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2. Responsibility

It will be the responsibility of the Photo Engineering personnel assigned to supervise and run all phases of the acceptance test and to handle the procurement of test film, instruments and other support materials as required. Technical assistance in other than photographic areas will be provided as required by coordination with Electronic and Engineering personnel.

3. Acceptance Test, Phase I

The criteria set forth in this plan are intended to serve as the minimum acceptable standards. Slight deviation from the procedures is permitted in order to utilize materials and personnel available during certain phases.

3.2 Documentation

3.2.1 A written detailed history will be maintained of all tests performed and results obtained.

3.3 Quality Control

3.3.1 Quality control will be exercised in all phases of this test to preclude introduction of contamination which would degrade test results during mechanical and sensitometric testing.

3.4 Processor

3.4.1 Exterior

3.4.1.1 Check exterior of machine for workmanship, i.e., loose or missing screws,

proper fitting of components, hardware, accessories, check for any signs of damage (and probable cause).

3.4.1.2 Check all materials used in construction to assure that component parts that come in contact with corrosive solutions are correct, i.e., SS 316, PVC, etc., and that steel screws are not used to mate with SS 316.

3.4.1.3 Check that all knobs, mounts, hoses, lines and rollers are in place and that correct electrical wiring is connected.

3.4.2 Installation

3.4.2.1 Check level and jack screws to insure that machine and main frame are rigid and not subject to stress.

3.4.3 Controls

3.4.3.1 Check the following controls for proper operation in sequence as outlined in operational manual, i.e., main power, drive, take up, air, vacuum, temperature, etc. During this phase check indicator lamps and fuses.

3.4.4 Air and Vacuum Units

3.4.4.1 Check air inlet for pressure at source and at indicator. Also check filtration of air to bearings.

3.4.5 Air Squeegees, Air Bearings and Vacuum

3.4.5.1 Check for evenness of flow and for proper operation and amount of control for air and vacuum.

3.4.6 Film Transport

3.4.6.1 Film, 70 mm, and 9.5-inches wide, in lengths of 500 feet each, will be run through machine without chemistry. In all components and bearings normally requiring chemistry, water will be substituted. This phase has no connection with the sensitometric evaluation.

3.4.6.2 Check for proper alignment and transport through all components from magazine through take up and note discrepancies. This test will be run under room lighting condition.

3.4.6.3 In conjunction with above, water filled replenishment system will be tested for rates and temperature control and all discrepancies noted.

3.4.6.4 Check for any erratic movement of the film during transport and at the vacuum roller in conjunction with the take-up roller assembly.

3.5 Electrical Components

3.5.1 Check all electrical mechanisms for operation.

3.5.1.2 Check electrical wiring for coding.

3.5.1.3 Check all electrical connections and components for secure mounting. Check ease of replacement of components such as pumps, relays, etc., that experience has shown will require periodic replacement during normal use.

3.5.1.4 Check all electric mechanisms for proper operation, i.e., motors, indicator light switches.

3.6 Mechanical Components

3.6.1 This phase depends on prior component testing. Check for secure mountings and connections prior to actual test run listed previously.

3.7 Quality Checks

3.7.1 Material utilized in testing will be closely checked for the following defects (exclusive of sensitometric testing):

- a. Scratches
- b. Folding due to tracking
- c. Abrasions
- d. Torn or ripped edges
- e. Sediment

3.7.1.1 Overall ability to maintain quality.

3.7.2 Processing

3.7.2.1 The following films shall be tested during the tracking phase:

- a. 9.5-inch wide thin base and heavy base (minimum 500 foot lengths).
- b. 70 mm wide thin base and heavy base (minimum 500 foot lengths).

4. Acceptance Test and Evaluation Report

4.1 Mechanical Test Phase

4.1.1 Consolidation of all results listed in 3. above.

4.2 Sensitometric Test Phase

4.2.1 Consolidation of all results listed in sensitometric test.

4.3.3 Graphs, charts, photographs and other materials will be used wherever possible to illustrate results.

4.4 The following format will be used for this report:

- a. Abstract
- b. Purpose
- c. Test Procedures
- d. Test Results
- e. Conclusions
- f. Recommendations
- g. Appendixes (This should include all materials, in 4.3, above required to support the conclusions.)
- h. Copy of the test plan.

5. Acceptance Test Phase II (See Sensitometric Test and Evaluation).

A rather extensive installation and initial test program has been supplied by the manufacturer. This procedure will be followed in the initial starting and testing of the machine. Following this, a repeatability evaluation phase will be initiated utilizing 9.5-inch material with NRD-29 chemistry at 100° F. The specific processing speed will be determined in a series of preliminary tests.

The uniformity tests will consist of two 500-foot rolls of 9.5-inch material run per day for two days. Throughout the length of these rolls 1951 USAF targets, uniform density exposure and step wedges will be exposed. Density measurements will be made on the processed material to determine the latitudinal processing uniformity,

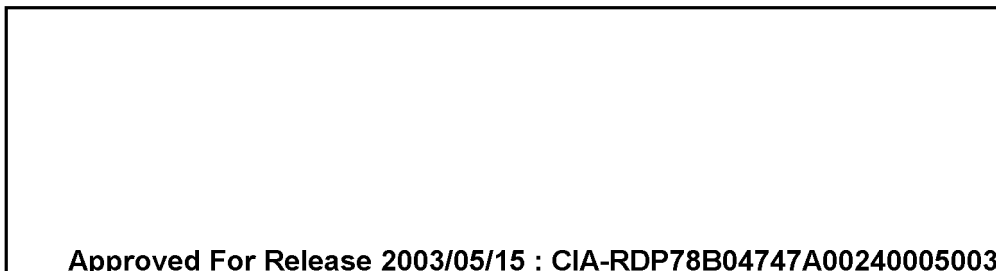
the inter-roll repeatability, the intra-roll repeatability and the day-to-day repeatability. The repeatability measurements will be stated as processing variances, associated with which will be a probability of conformance statement.

Also, at the time of the running this series of tests, the washing capability and quality will be evaluated in terms of the quantity of residuals remaining in the emulsion after the film has passed through the standard washing procedure within the processor. The criterion for comparison will be the standard permissible hypo quantities for archival quality washing.

Following the repeatability determinations, the conformance to the sensitometric standards, as listed in the manufacturer's operation manual, will be tested. The following data are for the various films to be tested and the sensitometric results are those taken to be the film manufacturer's standards:



The actual sensitometric curves will not be taken from the [] manuals as the curves presented therein are not representative of the specific emulsion batch being utilized and tests will be run with the same emulsion number. Curves, resulting from [] processing with NRD-29 developer at 110° F and the following film drive velocities will be provided:



These films will be evaluated in sensitometric test lengths for friskets of 10 feet each spliced in five increments, including head and tail throughout 1000 feet of the same emulsion film. Four wedges will be placed on each frisket and five friskets (70 mm and 9.5-inch) of each emulsion type will be processed under each condition. All wedges will be read two times on a diffuse densitometer, thus providing a measure of densitometer error. Also included in the friskets will be L targets, edges and uniform exposures for granularity analysis. Edge analyses will be performed on a limited basis, as will adjacency effect measurements. The latter are particularly valuable as an indication of processing induced nonlinearities.

Following the sensitometric testing, the uniformity-repeatability test will again be run and the latitudinal, inter-roll, intra-roll and day-to-day variances will again be determined and compared to those achieved in the first repeatability-uniformity test. If no differences exist, then the uniformity repeatability state of the processor will be taken as stable and the respective variance estimations from both tests will be pooled. If the results of the second test are not equal to those of the first, then the latest (second) estimate will be taken as the current variance and attempts will be made to locate the source and the cause of the variance inhomogeneity.

It will be noted that no mention has been made of the running of time-gamma-temperature curves for the emulsions under test. This is because the determination of these functions, on a reliable basis, is a time-consuming task. If the customer desires time-temperature-gamma functions to be generated, then it is best that he specify what variables and emulsions should be considered to permit maximum effort to be directed towards generating results that will be most beneficial in terms of the customer's needs.

TEST AND EVALUATION OF THE [] 9.5" FILM PROCESSOR

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A rather extensive installation and initial test program has been supplied by the manufacturer. This procedure will be followed in the initial starting and testing of the machine. Following this a repeatability evaluation phase will be initiated utilizing 9.5 inch [] material developed to a gamma of 2.0 with NRD-29 chemistry at 110°F. The specific processing speed necessary to obtain this gamma will be determined in a series of pretests.

The uniformity tests will consist of three 250 foot rolls of 9.5 inch [] material run per day for three days. Throughout the length of these rolls L bar targets, imagery, and step wedges will be exposed, as well as grainless exposures for granularity determinations. Density measurements will be made on the processed material to determine the latitudinal processing uniformity, the inter-roll repeatability, the intra-roll repeatability and the day-to-day repeatability. The repeatability measurements will be stated as processing variances associated with which will be a probability of conformance statement to the following tolerances:

latitudinal uniformity
density range

$$.65 < D < .95$$

tolerance in
diffuse density

$$\pm .02$$

inter-roll, intra-roll, and day-to-day repeatability

$$0.00 < D \leq 1.00$$

$$\pm .02$$

$$1.00 < D \leq 2.00$$

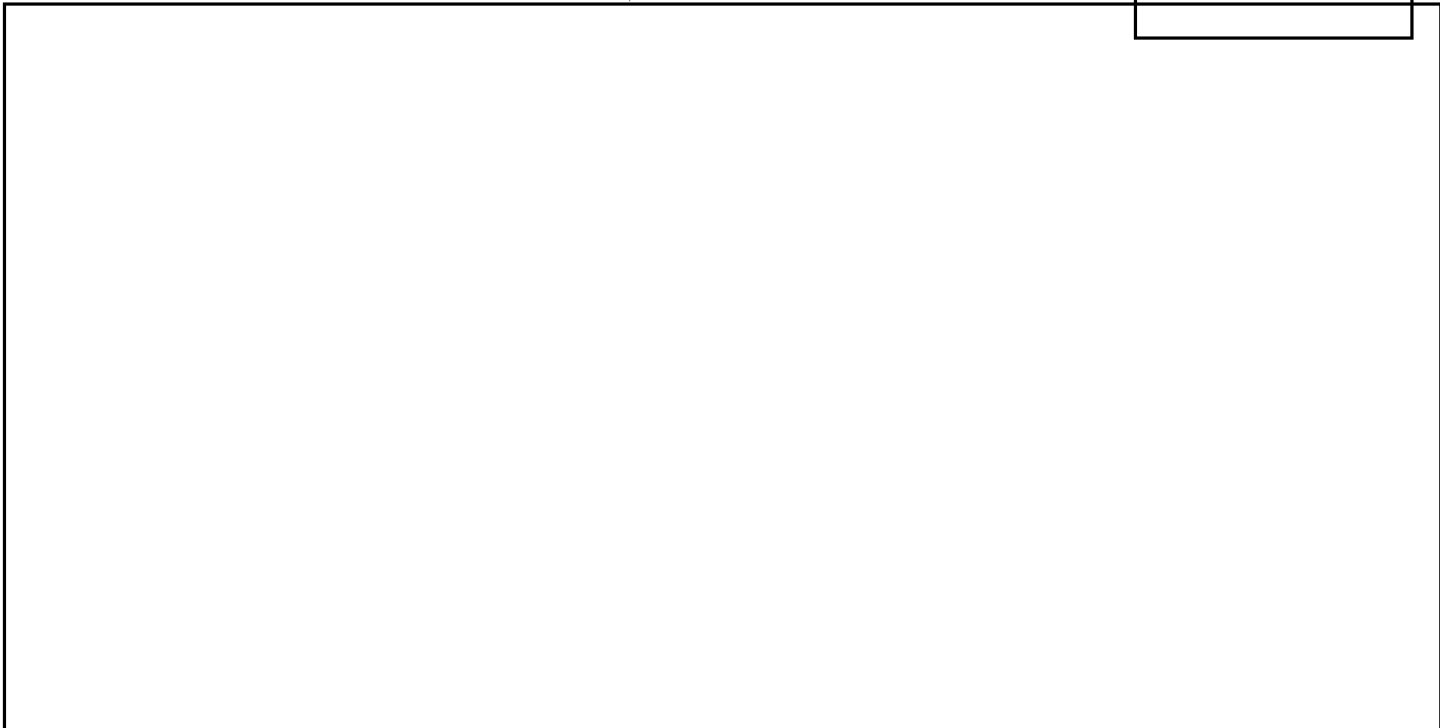
$$\pm .03$$

$$2.00 < D \leq 3.00$$

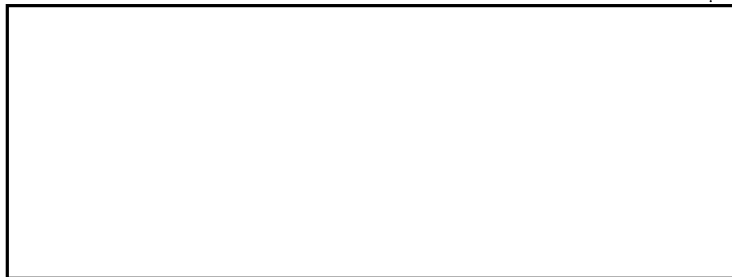
$$\pm .05$$

Also at the time of the running of this series of tests, the washing capability and quality will be evaluated in terms of the quantity of sulfur atoms remaining in the emulsion after the film has passed through the standard washing procedure within the processor. The criterion for comparison will be the standard permissible hypo quantities for archival quality washing.

STAT Following the repeatability determinations, the conformance to the sensitometric standards, as listed in the manufacturer's operation manual, will be tested. [REDACTED]



STAT The actual sensitometric curves will not be taken from the [REDACTED] manuals as the curves presented therein are not representative of the specific emulsion batch being utilized. The standard data will be generated utilizing the [REDACTED] Paddle Processor as the standard processor and utilizing the curves so produced in accordance with the above processing conditions, as a comparison base. Against this base will be compared the curves resulting from [REDACTED] processing with NRD-29 developer at 110°F and the following film drive velocities:



STAT These films will be evaluated in sensitometric test lengths or friskets of up to 50 feet each. Five wedges will be placed on each frisket and three friskets (70 mm, 5 inch and 9.5 inch) of each emulsion type will be processed under each condition. All

wedges will be read two times on a diffuse densitometer, thus providing a measure of densitometer error. Also included in the friskets will be L targets, edges and uniform exposures for granularity analysis. Edge analyses will be performed on a limited basis as will adjacency effect measurements. The latter are particularly valuable as an indication of processing induced nonlinearities.

If it is realized that different processing conditions will be required to achieve results that are comparable to the standard sensitometric conditions outlined above, then changes will be made first in the drive velocity and, as a second recourse, in the development time.

Following the sensitometric testing, the uniformity-repeatability test will again be run and the latitudinal, inter-roll, intra-roll and day-to-day variances will again be determined and compared to those achieved in the first repeatability-uniformity test. If no differences exist, then the uniformity-repeatability state of the processor will be taken as stable and the respective variance estimations from both tests will be pooled. If the results of the second test are not equal to those of the first, then the latest (second) estimate will be taken as the current variance and attempts will be made to locate the source and the cause of the variance inhomogeneity.

It will be noted that no mention has been made of the running of time-gamma-temperature curves for the emulsions under test. This is because the determination of these functions, on a reliable basis, is a time-consuming task. If the customer desires time-temperature-gamma functions to be generated, then it is best that he specify what variables and emulsions should be considered to permit maximum effort to be directed towards generating results that will be most beneficial in terms of the customer's needs.

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STAT T&E OF THE [] PROCESSOR

STAT []

1. Purpose

STAT The purpose of the test program is to determine if the [] STAT
[] processor meets the specifications as outlined in this test plan. The processor
must perform within the outlined standards to be considered acceptable.

2. Responsibility

2.1 It will be the responsibility of the Photo Engineering personnel assigned to supervise and run all phases of the acceptance test and to handle the procurement of test film, instruments and other support materials as required. Technical assistance in other than photographic area will be provided as required by coordination with Electronic and Engineering personnel.

3. Acceptance Test, Phase I

3.1 The criteria set forth in this plan are intended to serve as the minimum acceptable standards. Slight deviation from the procedures is permitted in order to utilize materials and personnel available during certain phases.

3.2 Documentation

3.2.1 A written detailed history will be maintained of all tests performed and results obtained.

3.3 Quality Control

3.3.1 Quality control will be exercised in all phases of this test to preclude introduction of contamination which would degrade test results during mechanical and sensitometric testing.

3.4 Processor

3.4.1 Exterior

3.4.1.1 Check exterior of machine for workmanship, i.e., loose or missing screws, proper fitting of components, hardware, accessories, check for any signs of damage (and probable cause).

3.4.1.2 Check all materials used in construction to assure that component parts that come in contact with corrosive solutions are correct, i.e., SS 316, PVC, etc., and that steel screws are not used to mate with SS 316.

3.4.1.3 Check that all knobs, mounts, hoses, lines and rollers are in place and correct electrical wiring is connected.

3.4.2 Installation

3.4.2.1 Check level and jack screws to insure that machine and main frame are rigid and not subject to stress.

3.4.3 Controls

3.4.3.1 Check the following controls for proper operation in sequence as outlined in operational manual, i.e., main power, drive, take up, air, vacuum, temperature, etc. During this phase check indicator lamps and fuses.

3.4.4 Air & Vacuum Units

3.4.4.1 Check air inlet for pressure at source and at indicator. Also check filtration of air to bearings.

3.4.5 Air Squeegees, Air Bearings and Vacuum

3.4.5.1 Check for evenness of flow and for proper operation and amount of control for air and vacuum.

3.4.6 Film Transport

3.4.6.1 Film, 70mm, and 9-1/2 inches wide, in lengths of 500 feet each, will be run through machine without chemistry. In all components and bearings normally

requiring chemistry, water will be substituted. This phase has no connection with the sensitometric evaluation.

3.4.6.2 Check for proper alignment and transport through all components from magazine through take up and note discrepancies. This test will be run under room lighting condition.

3.4.6.3 In conjunction with above, water filled replenishment system will be tested for rates and temperature control and all discrepancies noted.

3.4.6.4 Check for any erratic movement of the film during transport and at the vacuum roller in conjunction with the take-up roller assembly.

3.5 Electrical Components

3.5.1 Check all electrical mechanisms for operation.

3.5.1.2 Check electrical wiring for coding.

3.5.1.3 Check all electrical connections and components for secure mounting. Check ease of replacement of components such as pumps, relays, etc., that experience has shown will require periodic replacement during normal use..

3.5.1.4 Check all electric mechanisms for proper operation, i.e., motors, indicator light switches.

3.6 Mechanical Components

3.6.1 This phase depends on prior component testing. Check for secure mountings and connections prior to actual test run listed previously.

3.7 Quality Checks

3.7.1 Material utilized in testing will be closely checked for the following defects (exclusive of sensitometric testing):

- a. Scratches
- b. Folding due to tracking
- c. Abrasions
- d. Torn or ripped edges
- e. Sediment

3.7.1.1 Overall ability to maintain quality.

3.7.2 Processing

3.7.2.1 The following films shall be tested during the tracking phase:

- a. 9-1/2" wide thin base and heavy base (minimum 500' lengths).
- b. 70mm wide thin base and heavy base (minimum 500' lengths).

4. Acceptance Test & Evaluation Report

4.1 Mechanical Test Phase

4.1.1 Consolidation of all results listed in 3. above.

4.2 Sensitometric Test Phase

4.2.1 Consolidation of all results listed in sensitometric test.

4.3.3 Graphs, charts, photographs and other materials will be used wherever possible to illustrate results.

4.4 The following format will be used for this report:

- a. Abstract
- b. Purpose
- c. Test Procedures
- d. Test Results

- e. Conclusions
- f. Recommendations
- g. Appendixes (This should include all materials in 4.3 above required to support the conclusions.)
- h. Copy of the test plan.

5. Acceptance Test Phase II (See Sensitometric Test and Evaluation).

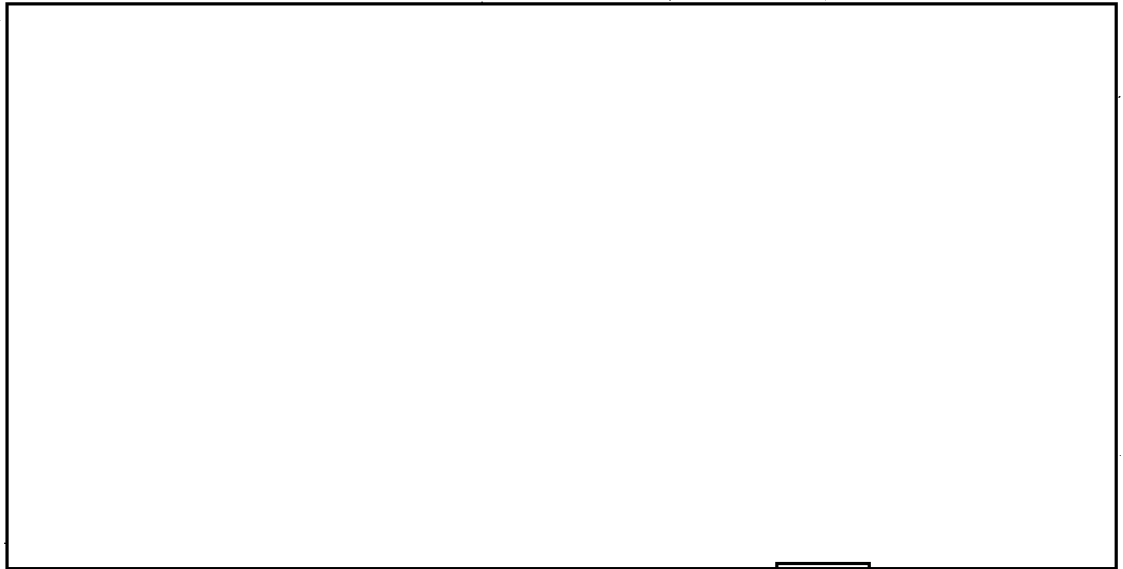
STAT A rather extensive installation and initial test program has been supplied by the manufacturer. This procedure will be followed in the initial starting and testing of the machine. Following this a repeatability evaluation phase will be initiated utilizing 9.5 inch [] material with NRD-29 chemistry at 100° F. The specific processing speed will be determined in a series of preliminary tests.

The uniformity tests will consist of two 500' rolls of 9.5 inch [] material run per day for two days. Throughout the length of these rolls 1951 USAF targets, uniform density exposure and step wedges will be exposed. Density measurements will be made on the processed material to determine the latitudinal processing uniformity, the inter-roll repeatability, the intra-roll repeatability and the day-to-day repeatability. The repeatability measurements will be stated as processing variances associated with which will be a probability of conformance statement. STAT

Also, at the time of the running this series of tests, the washing capability and quality will be evaluated in terms of the quantity of residuals remaining in the emulsion after the film has passed through the standard washing procedure within the processor. The criterion for comparison will be the standard permissible hypo quantities for archival quality washing.

Following the repeatability determinations, the conformance to the sensitometric standards, as listed in the manufacturer's operation manual, will be tested. [] STAT

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STAT The actual sensitometric curves will not be taken from the [redacted] manuals STAT as the curves presented therein are not representative of the specific emulsion batch being utilized and tests will be run with the same emulsion number. Curves, resulting from [redacted] processing with NRD-29 developer at 110°F and the following film drive STAT velocities will be provided:



These films will be evaluated in sensitometric test lengths for friskets of 10 feet each spliced in five increments, including head and tail throughout 1000 feet of the same emulsion film. Four wedges will be placed on each frisket and five friskets (70mm and 9.5 inch) of each emulsion type will be processed under each condition. All wedges will be read two times on a diffuse densitometer, thus providing a measure of densitometer error. Also included in the friskets will be L targets, edges and uniform exposures for granularity analysis. Edge analyses will be performed on a limited basis, as will adjacency effect measurements. The latter are particularly valuable as an indication of processing induced nonlinearities.

Following the sensitometric testing, the uniformity-repeatability test will again be run and the latitudinal, inter-roll, intra-roll and day-to-day variances will again be determined and compared to those achieved in the first repeatability-uniformity test. If no differences exist, then the uniformity-repeatability state of the processor will be taken as stable and the respective variance estimations from both tests will be pooled. If the results of the second test are not equal to those of the first, then the latest (second) estimate will be taken as the current variance and attempts will be made to locate the source and the cause of the variance inhomogeneity.

It will be noted that no mention has been made of the running of time-gamma-temperature curves for the emulsions under test. This is because the determination of these functions, on a reliable basis, is a time-consuming task. If the customer desires time-temperature-gamma functions to be generated, then it is best that he specify what variables and emulsions should be considered to permit maximum effort to be directed towards generating results that will be most beneficial in terms of the customer's needs.

Ref 30067

TEST AND EVALUATION OF THE

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[REDACTED] WIDE FILM PROCESSOR PROTOTYPE

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PHASE I (ENGINEERING EVALUATION)

I Evaluation and subsequent testing were accomplished as outlined in the attached program. This phase is objective insofar as design, workmanship, materials utilized in the fabrication of the machine and in general, good engineering principles and practice.

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II The purpose of this test and evaluation was to establish the parameters for acceptance of the [REDACTED] Processor by the using agency and evaluate the design and operation of the liquid and air bearings. The liquid and air bearing, although not new in concept or use, is utilized in the machine in a different configuration than previously attempted in a processor of this size. In the machine the liquid "bearing" is also the applicator for chemistry, and the air "knife" serves both as a support and a means for limiting carryover between solution compartments.

III Test procedures are as outlined in the attached program, and results are as follows:

3.4.1 As examination of the processor after uncrating, as well as during and after installation, revealed no damage to the machine.

One pump was loose on its base but was easily secured. All support equipment was found to be in good condition. The exhaust blower motor was changed from 110v AC to 220v AC for more efficient operation after approval was received from [] Project Engineer []

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All connections-plumbing, electrical, air and vacuum were checked and found to adhere to specifications.

3.4.2 All stainless steel and PVC work was excellent. Installation of the processor was accomplished without problems, due to minimal plumbing and wiring requirements.

3.4.3 All systems were checked in sequence as outlined in the manual. Results were good in all aspects, with the exception of temperature and its control.

3.4.4 Air and vacuum units checked and accepted.

3.4.5 Air squeegees, air bearings and vacuum roller accepted and considered well designed.

3.4.6 Film transport of a total of 2,000 ft. each of 70mm and 9 1/2 thin and heavy base (including 500 ft. of heavy film leader) film was excellent. All tanks during this phase were water filled, and machine was in full operational configuration for dry-to-dry evaluation. No abrasions or edge distortions were noted.

Temperature control was tested during all runs and temperature variations from liquid bearing impingement area to control indicator varied three (3°) to seven (7°) degrees. This phase was rechecked during the first sensitometric run and the differences ranged from two (2°) to three (3°) degrees.

3.5 Electrical components all acceptable and meet specifications.

3.6 Mechanical components were accepted with the following deficiencies noted.

a. ☐ film magazine, due to modification, will not accept the AF Standard 1,000 ft. spool and the light trap remains open when attached to the machine. Use of an AF Standard magazine, that adapts to the machine, and with a full 1,000 feet of film causes base abrasions in passing through the entry slit to splicer section. Unless modified, the light trap on the AF magazine will remain in the "open" position. Opening of the splice area could fog loaded film.

b. Front take-up roller "drawer" requires excessive force to remove and when in "operating" position, the air blast noise increases in intensity to an objectionable degree and causes continuous flutter of the film, which causes lateral abrasions of the film.

c. Speed control knob increments are too small for accuracy and require a tachometer to establish a true film trend speed. The use of the conversion chart to convert the arbitrary numbering system is of little value. As an example, the

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500' requirement
only - modified 3rd magazine

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☐ Engineering Manual recommends a speed of 4.75 ft/min. for drying ☐ film, but the increments on the conversion chart do not include this figure. A direct reading speed selector, calibrated in ft/min., is required.

d. Temperature control units, unless stated with cool chemistry, are difficult to adjust. Calibrated controls on each unit would be of considerable value. Lack of a cooling system makes the required temperature adjustments a time consuming and tedious task, particularly in respect to the allowable tolerances involved in $\pm 1/4^{\circ}\text{F}$ control (NOTE: In tests these tolerances were not held at the film impingement plane).

e. The drain pan should be extended to include the wash tank section and the drainage outlet should be made larger.

f. Full opening and draining of all tanks at one time is not possible due to limited pan capacity and small drainage opening.

g. Noise level extremely high. The Exhaust Blower should be mounted away from work area and redesign of the dryer assembly is recommended in order to lower the noise level and also reduce film flutter (Ref. 3.6.b. above)

h. Leakage or spillage drains onto electrical motors and pumps.

i. 1,000 foot roll pull through causes wrinkling at 90° turn around, take up idler roller.

NOTE: Due to the power requirements and physical characteristics of the processor, it is estimated that a minimum of eight (8) to ten (10) tons of air conditioning will be required to maintain equilibrium for the specified $70^{\circ}\text{F} \pm 5^{\circ}$ and $50\% \text{ RH} \pm 5\%$.

3.7 Dryer is inadequate and it is apparent that processing speeds, types and temperatures of chemistry are all dependent on the drying capability.

This phase of the test, although involving chemistry, will not be included in the Phase II Section, but will be mentioned at this point. Deficiencies noted based on high temperature processing:

- (1) The ratio of metol to hydroquinone is high.
- (2) Sodium sulphite concentration is not high enough.
- (3) It is our opinion that borax should be added to the hydroxide alkali buffer system.
- (4) Sulphate should be added to prevent the excessive swelling which is one of the primary reasons for the film drying problem. (Note: Chemistry tests will be continued in Phase II report.)

IV Conclusions (Engineering Phase Test and Evaluation)

STAT The Processor, as a prototype, is good in concept with exceptions noted in paragraph 3.6. The air knife and liquid bearing-applicator principles have been well adapted to the photographic process, and they do establish that it is possible to transport film with little or no abrasions, scratches or other defects that have been one of the major problems in film processing machines. The dryer section is poor in design. The loading design and drying section negate the possibility of transporting film dry-to-dry with no abrasions in the processors present configuration.

V Recommendations

From an engineering standpoint, the machine, as a prototype, is acceptable if the deficiencies noted are corrected. This recommendation does not include or pertain to the acceptability of the processor as a sensitometric, chemical, or controlled process machine. These questions will be discussed in Phase II report.

Rec'd 30 Oct 67

TEST AND EVALUATION OF THE

WIDE FILM PROCESSOR PROTOTYPE

PHASE II (SENSITOMETRIC EVALUATION)

- I Evaluation and subsequent testing were accomplished as outlined in the attached program, but due to the deficiencies noted in Phase I, Engineering Evaluation, the complete series of sensitometric tests was not considered feasible at this time.
- II The purpose of this testing was to establish a basis for the acceptance of the processor by the using agency. Specifications, as set forth by the using agency, were not available, but an objective approach to the evaluation was followed and limited to the quality of the product and sensitometric stability.
- III Test procedures that were used deviated from the original program and will be presented within the confines of the actual tests accomplished.

1. Chemistry

Sensitometric curves representative of processing runs indicate that high temperature and high agitation turbulence (potential oxidation of developing agent(s)) upset the formula balance, creating instability in the sensitometric control. The replenishment is based on a "demand" principle and varies from 1 to 3 quarts of developer during the processing of 500 feet of film. (70mm and 9 1/2 inch wide) Replenishment of other solutions vary according to capacity of their respective tanks. A foam build up was apparent in the wash section. Although not excessive, it caused a slight overflow around the edge of the cover. Reference Para. 3.7, Phase I, Testing for Correlated Deficiencies.

2. Sensitometric

Limited sensitometric testing was done [redacted]
[redacted] Dryer problems encountered in testing [redacted]
prevented a thorough evaluation of this film.

NOTE:

Discussion with the using agency resulted in limiting the testing to the two duplicating and one acquisition film; therefore, only the NRD-29 developer was used in accordance with the [] Manual.

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Testing of the [] fine grain duplicating film and [] acquisition film showed good drying of these materials is possible, although the temperature control of the infrared heater unit was somewhat critical. High velocity air turbulence in the dryer section caused lateral abrasions on both film types.

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Lateral density plots showed variations on [] film up to .04 density. Density variations on [] film were as high as .06 at a nominal density of 1.5.

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IV

Conclusions

The [] wide film processor prototype, from the standpoint of precision, high quality controlled processing, is not acceptable. As stated in the Engineering Phase, although good in the concept of the [] principle (air knife and liquid "bearings"), the processor is lacking in good engineering practice in respect to satisfactory loading-splicing design. Also the volume of drying air has not been controlled, or baffled, thereby creating excessive film flutter which is the major cause of the film abrasions that is apparent on test films processed which include thick and thin bases. Sensitometric control is not possible and can be attributed to the Replenishment System which is a "demand" type system. On a processor of this design, it is not controllable. For precision processing it was noted that the developer replenishment bottle, due to back pressure in the circulation system, received "back up" of oxidized developer. The unpredictable flow of chemicals and the lack of sufficient fresh chemistry in the system not only changed the chemical balance, but a definite increase in KBr was noted. High temperature processing required by the short developer time in the processor will require chemistry other than recommended in the [] Manual.

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In the dryer section the infrared, in conjunction with warm air impingement, requires critical and balanced control and could be considered extremely difficult with the existing configuration and control system. The distance between

the wet section air knife, and the infrared area, then into the film guide air cluster is too short. At this critical point drying is minimum upon entry into the cluster causing the flutter abrasions to be unacceptable by normal standards.

V

Recommendations

STAT The Processor is not acceptable in its present design as a controlled process unit.

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October 23, 1967

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MEMORANDUM

SUBJECT: Mechanical Evaluation of Problem Areas — [] Processor

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The following deficiencies are noted in [] memorandum of

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October 13, 1967, Phase I and Phase II of his test evaluation.

I. Dryer Section

- A. Inadequate drying of heavy-base film
- B. Film flutter and abrasions in air knife drawer
- C. 90° turn roller creasing film

II. Tank — Module Section

- A. Foaming and overflow
- B. Contamination and inadequate replenishment system

III. Transport System

- A. Speed control — inadequate
- B. Speed readout — inadequate
- C. Eliminate conversion chart
- D. Modification of [] magazine to accept 1,000-foot spools, redesign light trap
- E. Exhaust blower too noisy
- F. Liquid leakage on motors
- G. Loading splicing design

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The [] Processor was inspected and a quick appraisal was made

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October 26, 1967

Dear Ray:

Attached is a copy of my report [redacted] and also a copy of a report from our engineering people. Thought they would be of interest both from a Photo and Design evaluation.

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of the design and tested performance of the device versus the designer's indicated performance specifications.

The initial impression is that an apparently sound basic design, good choice of materials, and, in general, quality workmanship produced a pretty good prototype processor, which with adequate testing and debugging would result in acceptable hardware. The problems outlined by the test and evaluation reports were investigated as thoroughly as possible in the available time. With some redesign, these problems can possibly be eliminated or reduced to an acceptable level. The most serious problem appears to be that of the drying air knife drawer and film abrasion.

Possible solutions to the problems that were indicated are listed below:

I. Dryer Section

A. Inadequate drying (thick film)

This problem is related to two others, the infrared unit and the air knife drawer. Although drying is adequate with thin-base films, the one dryer unit is unable to dry the thicker films. An additional infrared unit mounted below the film and some redesign of the drawer unit may correct this problem. This area is rather complex. A solution that has a high probability of success will require tests and more thought than was possible during this cursory investigation. Tests may be required in which air flow, temperature, and humidity versus performance are checked at all critical points of the processor.

B. Film flutter and abrasions

This problem occurs in the air knife drawer and may be related to excess air flow. Baffling, or reducing the air supply in this area, may

eliminate this condition.

As previously stated, a study and redesign of this area is required.

C. 90° turn roller — film creasing

A redesign of the roller, eliminating the center flange, may correct this. In addition, if a warm air bearing roller were used, this would provide a non-contact, abrasion-free surface and augment drying.

II. Tank Modules

A. Foaming and overflow

As stated in I-A, reducing the amount of air flow along with baffling should help. The suction system should be checked to insure sufficient negative pressure in the covers. Larger diameter vent hoses may be required. *Quick Disconnect hoses -*

B. Replenishment System

Addition of a float control and larger external supply tanks should eliminate this problem.

III. Transport System

A. Speed Control

B. Readout

C. Conversion chart

This basic electronic control problem may require a good S.C.R. motor control with calibrated tach readout on the motor shaft, and special direct readout meter scale.

D. ☐ Magazine — modification

No obvious solution at this time. Some study and redesign should solve this.

E. Excess blower noise

Blowers of the type required to deliver large quantities of air needed are inherently noisy beasts. Possibly the only solution is remote mounting and sound proofing.

F. Liquid leakage on motors.

If this is a serious problem, the motors may be remounted in sheltered locations or changed to totally enclosed shielded motors.

G. Loading design

No solution at this time. Requires study and redesign. Could be a sticky problem.

SUMMARY

STAT This mechanical evaluation of the [] prototype processor must, STAT
due to the limited time available and lack of actual air flow and other data, be biased
by this fact. Sure-fire solutions to the problems are not at this time obvious. Based
upon discussion [] it appears apparent that a change
in the air supply system should eliminate the major deficiencies noted in the dryer
section and the tank module section.

None of the mechanical problems appear to be extremely difficult. Before the
extent of redesign or modification can be determined, a well thought out test plan, yielding
meaningful air flow data, should be done.

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DRYER INTAKE AIR

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TEMPERATURE

10 X 10 TO THE CM. 358-14
KEUFFEL & ESSER CO. MADE IN U.S.A.

0800

0900

1000

TIME SCALE

ENCLOSURE # 7

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1600

1700

DEVELOPER

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TEMPERATURE

10 X 10 TO THE CM. 358-14
KEUFFEL & ESSER CO. MADE IN U.S.A.

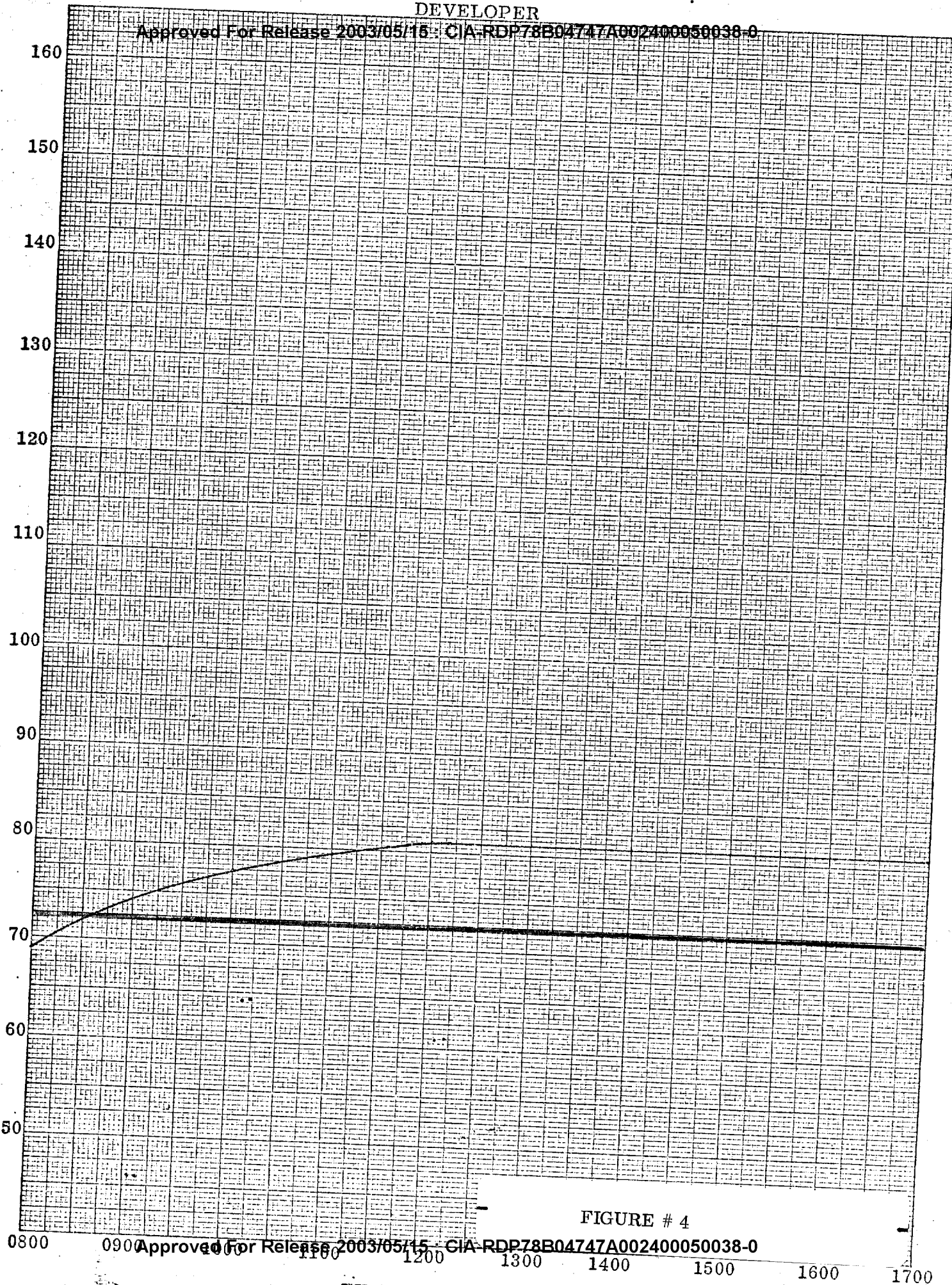


FIGURE # 4

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TIME SCALE

SHORT STOP

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TEMPERATURE

10 X 10 TO THE CM. 358-14
KEUFFEL & ESSER CO. MADE IN U.S.A.

160
150
140
130
120
110
100
90
80
70
60
50

0800

0900

1000

1100

1200

1300

1400

1500

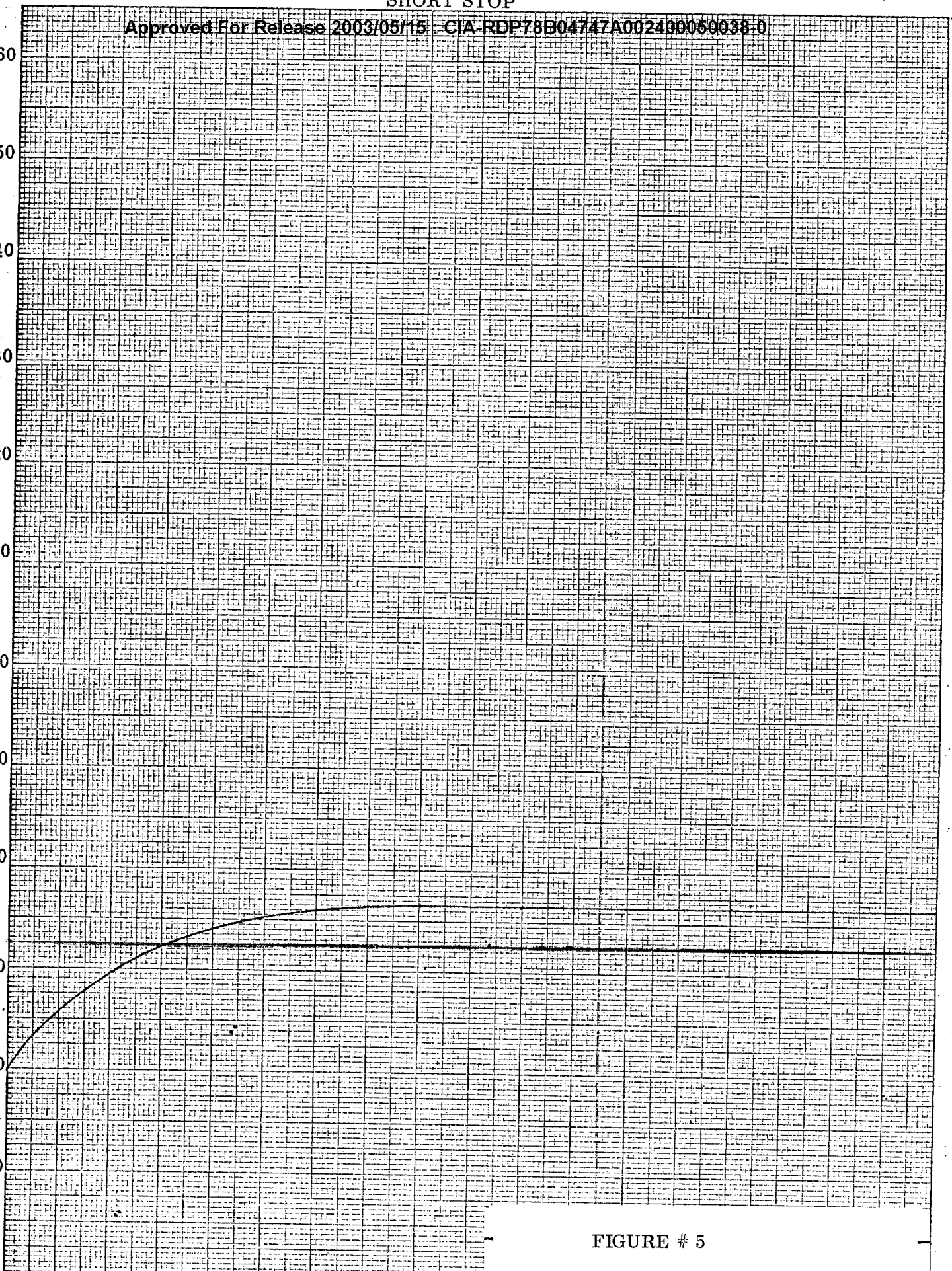
1600

1700

Approved For Release 2003/05/15 : CIA-RDP78B04747A002400050038-0

TIME SCALE

FIGURE # 5



FIX

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TEMPERATURE

10 X 10 TO THE CM. 358-14
KEUFFEL & ESSER CO. MADE IN U.S.A.

160
150
140
130
120
110
100
90
80
70
60
50

0800

0900

Approved For Release 2003/05/16 : CIA-RDP78B04747A002400050038-0

1300

1400

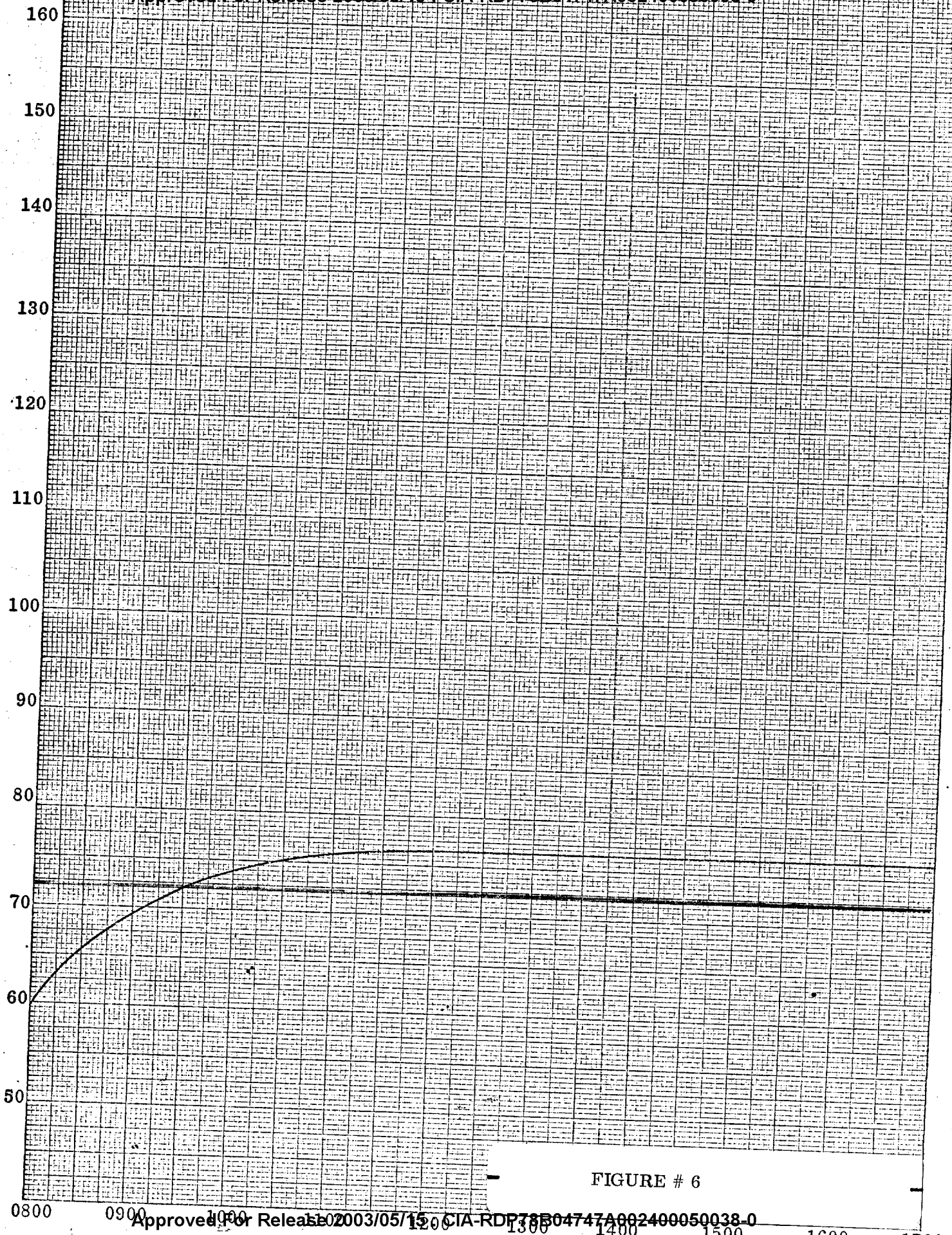
1500

1600

1700

TIME SCALE

FIGURE # 6



PROCESSOR INTERIOR (PUMP AREA)

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TEMPERATURE

K&E 10 X 10 TO THE CM. 358-14
KEUFFEL & ESSER CO. MADE IN U.S.A.

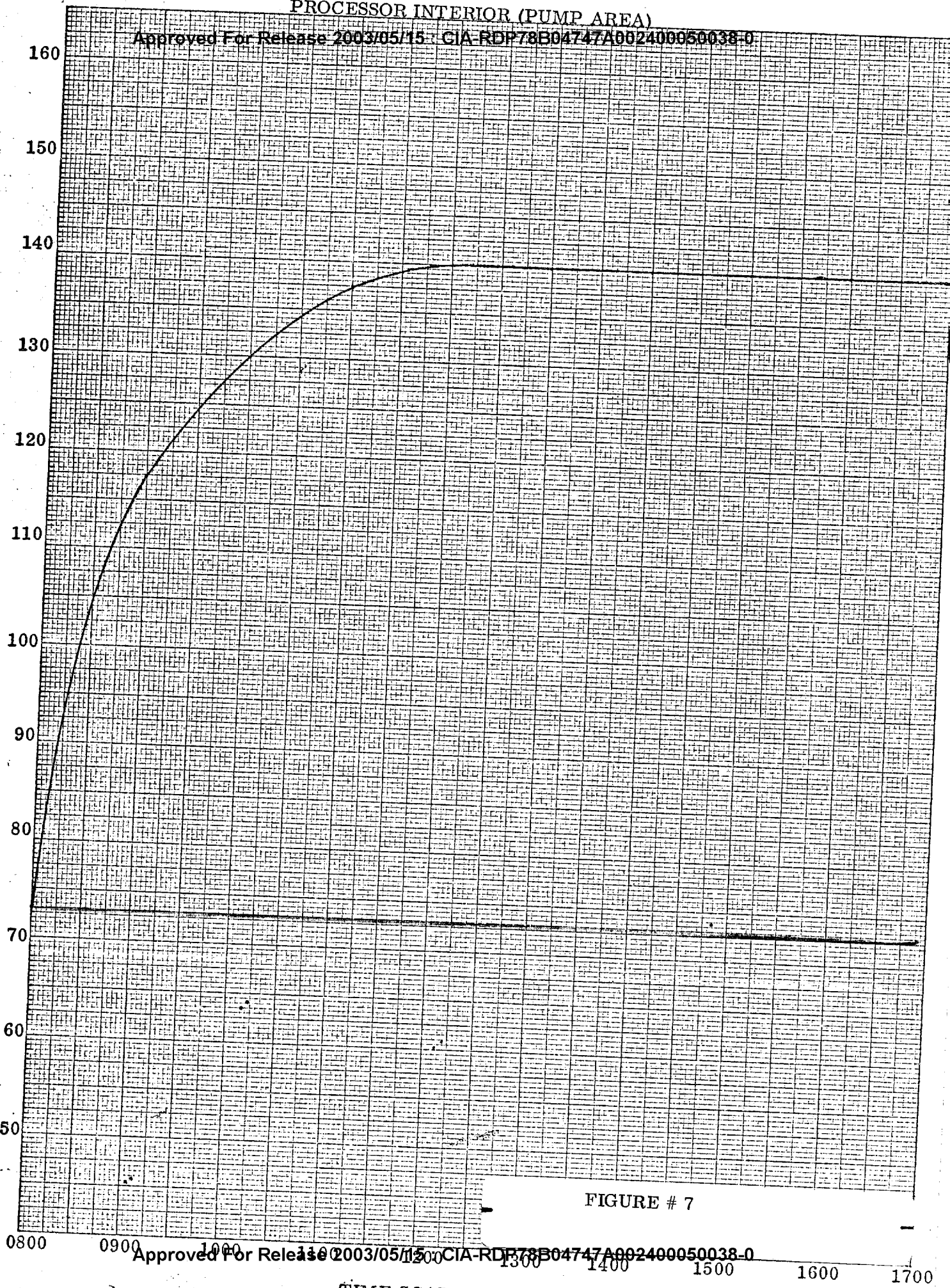


FIGURE # 7

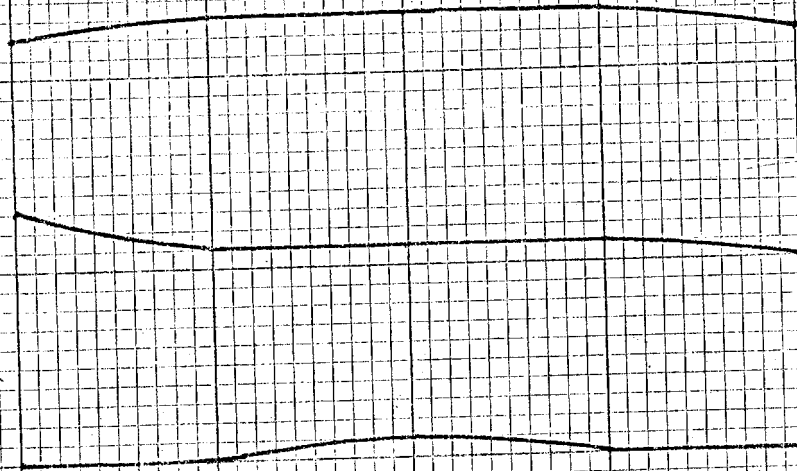
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TIME SCALE

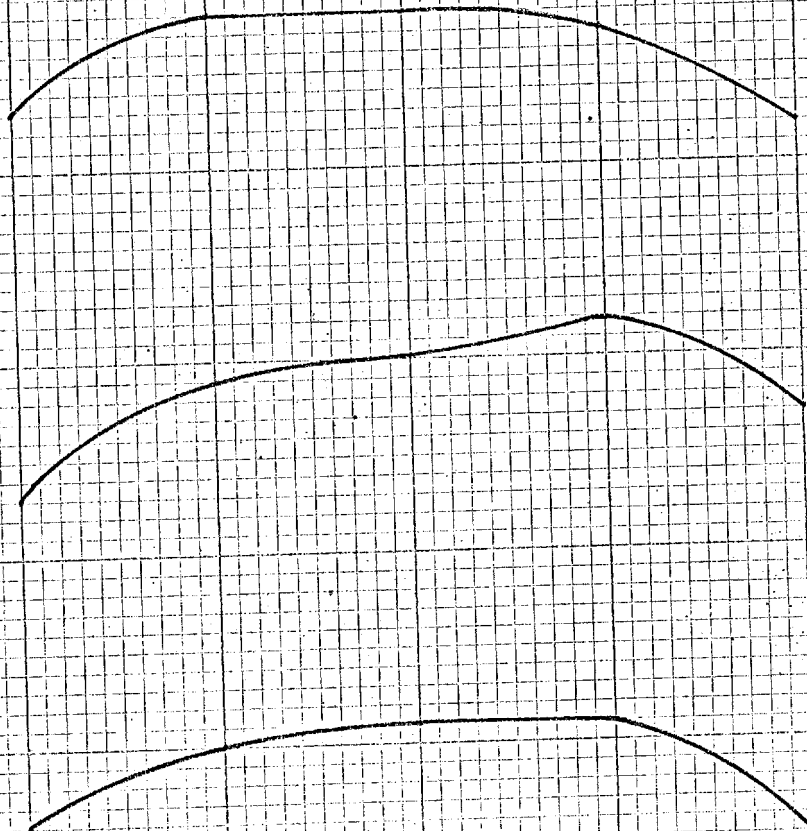
AVERAGE LATERAL DENSITY SPREAD

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With Three (3) Center Jets Closed



With Three (3) Center Jets Open



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FIGURE # 3

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